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⑳ Display control device for reducing power consumption.

⑳ A display control device for receiving input data at a display controller-kernel unit, storing it in a memory, sequentially reading the stored data from the memory and displaying it on a display unit. The control device comprises a counter which is reset when a signal indicating writing of data in the memory is detected to output a counter signal when a predetermined value is counted, a display control circuit for outputting a control signal so as to close a gate inserted in a signal line between the display controller-kernel unit and the display unit in response to the counter signal to interrupt the signal line and turn off the backlight of the display unit, and means for invalidating the control signal when the fact that a signal is written in the memory is detected.

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This invention relates to a display control device where in order to reduce power consumption, input data is stored to be sequentially displayed on a display screen and, particularly, to a display control device adapted to turn off a display unit as long as no change in a displayed content takes place.

A display control device is well known in which input data is stored in a memory and displayed sequentially on a screen. In such a display control device, a display controller-kernel unit delivers a control signal to a display panel, such as a liquid crystal display (LCD) panel or the like, in accordance with control instructions from an external unit, such as a central processing unit (CPU), to commence the control of the display panel and also stores data (character codes) fed from the CPU in a memory. The stored data are successively read from the memory, converted by the display controller-kernel unit to data to be displayed (character patterns) and fed to the display panel for display.

Since the above-referred display control device reads the content of the memory to cause it to be displayed on the display screen even when no change in displayed content takes place, there is a drawback in that power is consumed even when no data are required to be displayed.

It is well known to turn off a display screen when no data are required by displayed. For example, Japanese Patent Public Disclosure No. 9634/86 laid open on January 17, 1986 discloses a display control device for causing data to be displayed for a predetermined period of time in response to an operation of an input means. It is, however, necessary in such a prior art to provide an additional software to the control device and change a display controller-kernel unit, which will result in an increase in the size and cost of the device.

Japanese Patent Public Disclosure No. 112371/84 laid open on June 28, 1984 also discloses a technique for automatically turning off a screen when a predetermined period of time for which the same image is displayed has lapsed. This technique also has such problems as mentioned above.

The present invention has been made to solve such problems. It is an object of the invention to provide a display device capable of reducing a power consumption of a display control device, by adding simple circuits thereto, when no data are required to be displayed.

To attain this purpose, the present invention, in one aspect, provides a display control device for causing input data to be stored in a memory to sequentially read the stored data for causing them to be displayed on a display unit, the device com-

prising:

timer means for detecting the fact that no data is written in the memory for a predetermined period of time; and

5 control means for disabling the display unit in response to the output of the timer means; whereby a power consumption of the display unit is reduced.

The timer means may be a counter which is 10 reset in response to the writing of the data in the memory and provides an output signal when the counter has counted up to a value corresponding to the predetermined period of time.

The display control device according to the 15 invention may further comprise gate means inserted in a signal line connecting the memory and the display unit, the control means being operable to close the gate means and disable the display unit in response to the signal output from the counter.

20 The display unit may be an LCD panel and the control means may be operable to turn off the backlight of the LCD panel.

According to another aspect of the invention, 25 the present invention provides a display control device including a display controller for receiving input data, storing it in a memory, sequentially reading the data stored in the memory and transmitting it to a display unit, the device comprising:

30 timer means for generating an output at the time when a predetermined period of time has lapsed from the time of the data being written in the memory;

35 gate means inserted in a signal line connecting the display controller and the display unit; and

control means for closing the gate means in response to the output of the timer means to disable the display unit, and for opening the gate means in response to the writing of the data in the 40 memory to enable the display unit.

The display controller and the LCD panel may be connected by a signal line for transmitting a data shift clock as well as by a signal line for transmitting LCD data, and the gate means may be 45 inserted in these signal lines.

According to a further aspect of the invention, the present invention provides a display control device for receiving input data at a display controller-kernel unit, storing it in a memory and sequentially reading the stored data from the memory and displaying it on a display unit, the device comprising:

50 a counter which is reset when a signal indicating writing of data in the memory is detected to output a counter signal when a predetermined value has been counted;

55 a display control circuit for outputting a control signal so as to close a gate inserted in a signal line

between the display controller-kernel unit and the display unit in response to the counter signal to interrupt the signal line and turn off the backlight of the display unit; and

means for invalidating the control signal when the fact that a signal is written in the memory is detected.

The foregoing and other objects and advantages of the invention will become more apparent from the following detailed description with reference to the accompanying drawings.

Fig. 1 is a block diagram showing the structure of an embodiment of a display control device in accordance with the present invention; and Fig. 2 is a flow chart for explaining an operation of the display control device of Fig. 1.

Fig. 1 is a block diagram showing the structure of an embodiment of a display control device in accordance with the present invention. In the drawing, a display controller-kernel unit 1 is connected to a CPU bus 2 which transmits a control signal from a CPU (not shown). The display controller-kernel unit 1 is also connected through a memory bus 3a to a memory 3 and delivers a control signal to a control signal line 4a, a data shift clock to a clock line 4b and a display data to a data line 4c. The display controller-kernel unit 1 is further connected through the signal line 4a to an LCD panel 4.

The memory bus 3a is connected to a reset terminal of an internal counter 5, and the control signal line 4a is connected to a count terminal of the internal counter 5. The counter signal or output of the internal counter 5 is output to a signal line 5a.

The internal counter 5 is connected through the signal line 5a to a display control circuit 6. The display control circuit 6 delivers a clock control signal to a signal line 6a, a data control signal to a signal line 6b and a backlight control signal to a signal line 6c.

A clock gate 7 and a data gate 8 are inserted in the signal lines 4b and 4c, respectively, connecting between the display controller-kernel unit 1 and the LCD panel 4, the signal line 6a being connected to both of the gates, the signal line 6b to the data gate 8 and the signal line 6c to the LCD panel 4.

In operation, when control instructions are fed from the CPU through the CPU bus 2 to the display controller-kernel unit 1, it delivers the LCD control signal through the signal line 4a to the LCD panel 4 and commences the control of the LCD panel 4.

The display controller-kernel unit 1 produces a memory control signal for controlling the memory 3 and a data shift clock pulse for storing the data (character codes) fed through the CPU bus 2 in the

memory 3. The data stored in the memory 3 are sequentially read, converted to display data (character patterns) and output to the LCD display data line 4c.

5 The internal counter 5, when it detects the fact that a write-in signal has been output to the memory bus 3a, clears its count values and receives the LCD control signal from the signal line 4a to commence a counting operation (Steps S1 - S3 of Fig. 2). Simultaneously, the display control circuit 6 operates to open the clock gate 7 and the data gate 8 by the clock control signal and the data control signal, whereby the display data fed through the data line 4c is updated by the clock pulse supplied through the LCD data shift clock line 4b and displayed on the LCD display panel 4.

10 If no write-in signal is detected on the memory bus 3a during a predetermined value has been counted and a predetermined period of time has lapsed, a counter signal is delivered to the counter signal line 5a (Steps S4 - S5).

15 When detecting the counter signal on the signal line 5a, the display control circuit 6 delivers the clock control signal, the data control signal and the backlight control signal to the signal lines 6a, 6b and 6c, respectively, so that the clock gate 7 and the data gate 8 are closed by the clock control signal and the data control signal and the backlight of the LCD panel 4 is switched off, thus causing the display of the LCD panel 4 to be turned off (Steps S6 - S7).

20 When a write-in signal is output again to the memory bus 3a while the display is being turned off, the display control circuit 6 operates to cancel all of the clock control signal, data control signal and backlight control signal which have been output up to this time (Steps S8 - S9), and the display is recovered on the LCD panel 4.

25 In this manner, this embodiment operates to turn off the display unit after a predetermined lapse of time defined by the counter 5, in the event that no change in display content takes place, and thus a power consumption is reduced when no data are required to be displayed.

30 35 40 45 Although the present invention has been described in detail with reference to a preferred embodiment, various modifications and alterations can be effected without departing from the scope and spirit of the invention. In stead of the LCD panel, for example, a CRT, plasma display or the like can be used as a display unit.

Claims

45 50 55 60 65 1. A display control device for storing input data in a memory, sequentially reading the stored data and displaying it on a display unit, said control device comprising:

timer means for detecting the fact that no data is written in said memory for a predetermined period of time; and

control means for disabling said display unit in response to the output of said timer means;

whereby a power consumption of said display unit is reduced.

2. A control device as set forth in Claim 1, wherein said timer means is a counter which is reset in response to the writing of the data in said memory and provides an output signal when said counter has counted up to a value corresponding to the predetermined period of time.

3. A control device as set forth in Claim 2, further comprising gate means inserted in a signal line connecting said memory and said display unit, said control means being operable to close said gate means and disable said display unit in response to the signal output from said counter.

4. A control device as set forth in Claim 3, wherein said display unit is an LCD panel and said control means is operable to turn off the backlight of said LCD panel.

5. A display control device including a display controller for receiving input data storing it in a memory, sequentially reading the data stored in the memory and transmitting it to a display unit, said control device comprising:

timer means for generating an output at the time when a predetermined period of time has lapsed from the time of the data being written in said memory;

gate means inserted in a signal line connecting said display controller and said display unit; and

control means for closing said gate means in response to the output of said timer means so as to disable said display unit, and for opening said gate means in response to the writing of the data in said memory to enable said display unit.

6. A control device as set forth in Claim 5, wherein said timer means is a counter which is reset in response to the writing of the data in said memory and provides an output signal when said counter has counted up to a value corresponding to the predetermined period of time.

7. A control device as set forth in Claim 6,

5 wherein said display unit is an LCD panel, and said control means is operable to receive the output from said counter for disabling the backlight of said LCD panel and to detect the writing of the data in said memory for enabling said backlight.

8. A control device as set forth in Claim 7, wherein said display controller and said LCD panel are connected by a signal line for transmitting a data shift clock as well as by a signal line for transmitting LCD data, said gate means being inserted in these signal lines.

15 9. A display control device for receiving input data at a display controller-kernel unit, storing it in a memory, sequentially reading the stored data from said memory and displaying it on a display unit, said control device comprising:

20 a counter which is reset when a signal indicating writing of data in said memory is detected to output a counter signal when a predetermined value has been counted;

25 a display control circuit for outputting a control signal so as to close a gate inserted in a signal line between said display controller-kernel unit and said display unit in response to said counter signal to interrupt said signal line and turn off the backlight of said display unit; and

30 means for invalidating said control signal when the fact that a signal is written in said memory is detected.

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Fig. 1

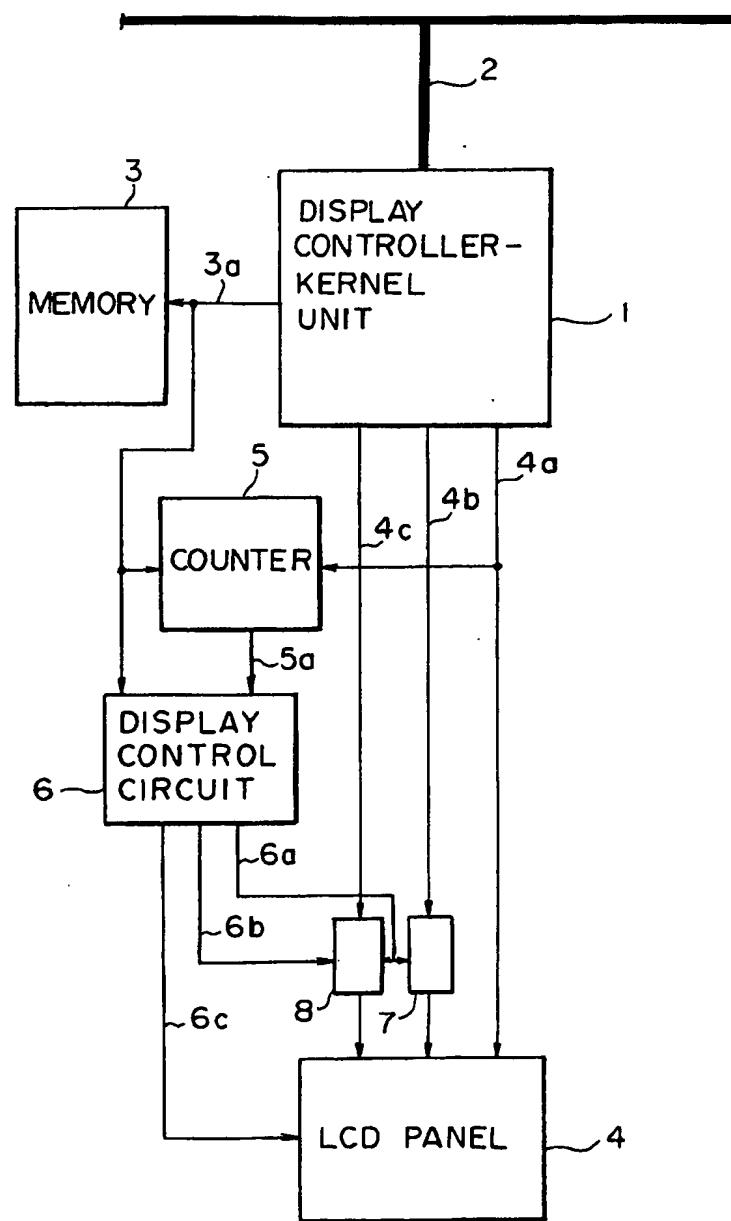


Fig. 2

